

Bloom and toxin occurrence

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Fresh water is a renewable but a finite and vulnerable resource and essential to sustain life, development and the environment. In fact 97.3 percent of earth's water is saline and 2.7 per cent is fresh water. 70 per cent of this fresh water is frozen in ice caps of Antarctica and green land and balance is present either as soil moisture or underground moisture. As a result less than 1 per cent of all the water on earth is accessible for direct human use. This water is found in lakes, rivers, reservoirs etc. Only this tiny portion of the planet's water is recycled by nature's cycle.

Water is getting scarce due to rising population, rapid urbanization and growing industrial demands. People dump wastes, untreated sewage and chemical discharges, which pollute the sources of water like rivers, lakes, ponds and even underground resources. The most significant issues of water ecosystem is the eutrophication and deteriorating water quality including the development of numerous harmful algal blooms. Significant impacts of these blooms are high biomass, visible surface scums, loss of submerged aquatic vegetation and benthic habitat. Harmful cyanobacterial blooms produce toxins and affect commercial species like fish etc. Non-toxic blooms affect the benthic flora and fauna due to decreased light penetration. These blooms also affect the recreational activities of humans.

Microcystis aeruginosa is the most common cyanobacterial HAB not only in US but also all over the world in fresh, eustarine and marine waters. Other toxic blooms formed by *Lyngbya majuscula*, *Schozothrix calcicola*, *Oscillatoria nigroviridis* cause swimmer's itch and these are commonly found in tropical and sub-tropical sea waters. *Anabaena flosaquae*, *Aphanozomenon flosaquae* are the common cyanobacterial toxic blooms. *Gleotrichea intermedia*, *Aphanothece gelatinosa*, *Anabaena iyengarii*, *Cylindrospermum stagnale*, *Scytonema javanicum*, *Scytonema simplex*, *Oscillatoria princeps*, *Nodularia*, *Lyngbya martinsiana*, *Phormidium anomala*, *Nostoc commune* are the other common toxin producing cyanobacterial blooms.

Cyanobacterial blooms which are toxic in fresh water may not be necessarily toxic marine environment or vice versa. In general toxic cyanobacterial blooms are same or similar all over the world. According to the literature 25 per cent of cyanobacterial blooms produce toxins. Cellular target phytoplankton toxins are ichthyotoxins, neurotoxins, hepatotoxins, hemolysins and cytotoxins. Most commonly observed toxins all over the world are:

Paralytic shellfish poisoning toxins (PSP) – water soluble neurotoxins.

Amnestic shellfish poisoning toxins (DSP) –water soluble neurotoxins

Neurotoxic shellfish poisoning toxins (NSP) –lipid soluble brevetoxins

Ciguatera fish poisoning toxins (CFP) –lipid soluble heat stable.

These are the most commonly observed toxins in US and all over world in marine and eustarine waters. If the trend of eutrophication continues in the same manner cyanobacterial HABs will increase proportionately and pose a greater threat not only to natural ecosystems but also to the human health. Therefore, there should be legislative actions to ensure that efforts to achieve nutrient reduction and establish a water quality standard.

Public education is one of the major tools other than scientific research in efforts to minimize the impacts of Cyanobacterial HABs and their toxins in marine, eustarine and fresh waters.